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April 8, 1997

Mr. William F. Caton
Secretary
Federal Communications Commission
1919 M. St., NW, Room 222
Washington, D.C. 20554

RE: Ex Parte Presentation
Access Reform: CC Docket No. 96-262

RECEIVED
APR 29 1997
Federal Communications Commission
Office of Secretary

Dear Mr. Caton,

Today I met with Robert Loube, William Sharkey and Whiting Thayer of the Common Carrier Bureau. Several issues were discussed at these meetings. These included:

- a) the analog and digital data carrying capabilities of Hatfield long loops;
- b) further evidence provided in public RBOC testimony that corroborates the switching costs assumed in Hatfield; and
- c) a list of directions to perform edits to Release 3.1 of the Hatfield Model, as requested by the Commission staff.

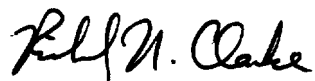
In particular, in response to certain misrepresentations of the data carrying capability of the long loops engineered in the Hatfield Model, Hatfield Associates contracted with an independent modem testing laboratory, Henderson Labs to quantify the transmission capabilities of these loops. The attached technical report from Henderson Labs confirms, that even extremely long loaded loops on both ends of the connection (an event that is exceedingly rare in the Hatfield Model) retain roughly 84% of the data throughput experienced on normal loops. Furthermore, Hatfield Associates demonstrates that if full digital subscriber loop capabilities are desired, there is a more cost-efficient technology to bring this capability to sparsely populated rural regions than uncontrolled multiplication of fiber remote terminals.

The second item submitted is certain testimony of Southwestern Bell before the Texas PUC. In this testimony Southwestern Bell confirms that the switch prices assumed in the Hatfield Model are right in line with actual prices paid by LECs. This sworn testimony appears to be contrary to allegations about switch prices that have been proffered by LECs based on studies that they have held proprietary.

The third item is a listing of edits that may be performed to the 2/28/97 CD-ROM release of the Hatfield Model, version 3.1. These directions demonstrate how to adjust the HM3.1 distribution and expense modules to correct a number of inadvertent flaws that have been discovered in the 2/28/97 release.

Two copies of this Notice are being submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(1) of the Commission's rules.

Sincerely,

A handwritten signature in black ink, appearing to read "Richard N. Clarke".

Richard N. Clarke

Attachments

cc: Anthony Bush (w/o atts)
Robert Loube (w/o atts)
William Sharkey (w/o atts)
Brian Clopton (w/o atts)
Whiting Thayer
State Joint Board Staff

**Analog and Digital Data Carrying Capabilities
of Hatfield Long Loops**

Modem Performance on Long Loaded Loops in the Hatfield Model

Summary Report

1.0 Introduction

Performance of voice-band modems designed for use in switched telephone networks has improved profoundly over the past several years, and improvements continue as modem signal processing techniques advance. Currently-available modems, including those that have been on the market for the past few years, are "intelligent" in that they automatically adapt their transmission techniques to the characteristics of the channel over which they are to communicate. The modem communications channel in switched applications will consist of two loop components, one on either end of the overall connection, plus at least one switching machine. If more than one switch is involved, interoffice transmission facilities will be required to carry the signal between switches.

Version 3.1 of the Hatfield Model (HM3.1) occasionally, but rarely, models very long loops that require the use of load coils to reduce distortion across the voice bandwidth. Although modern modems, as noted above, adapt themselves to accommodate channel impairments, including the effects of load coils, there has been little written in publicly-available articles or technical papers that discusses specifically the effects of loading coils and other long-loop transmission characteristics on the performance of today's modems.¹

To obtain a reliable assessment of the performance of commercially-available V.34 modems over various loop designs (including loaded loops) and network configurations, Hatfield Associates, Inc., contracted with Henderson Laboratories, Inc., an independent modem testing laboratory, to test and report the performance of two popular V.34 modem models (one moderately priced, another a bit more expensive) using standard loop and network configurations and test procedures.

The following discussion summarizes the results of the Henderson Laboratories tests. The complete test results and description are attached as an appendix to this document.

2.0 Summary of test results

To standardize models and test procedures used for evaluation of two-wire modems, the Telecommunications Industry Association (TIA) has published Telecommunications Systems Bulletins describing network models² and test procedures to be used in characterizing modem

¹ All references to modems in this discussion as well as in the attached report, assume modems designed in accordance with ITU-T Recommendation V.34. These are called "V.34 modems."

² Telecommunications Industry Association, TSB37-A, "Telephone Network Transmission Model for Evaluating Modem Performance," October, 1994.

performance.³ The attached report from Henderson Labs discusses the set of network connections, loop types and test procedures specified by the TIA in its publications.

The Henderson Labs test results are extensive and include all combinations of TIA-specified network connections and loop types for intracontinental transmission. Of these combinations, the most useful ones for the purposes of this discussion are those that pertain to the all-digital network connections modeled by HM3.1. Network connection type 17 contains all-digital switching and transmission, hence is the most forward-looking of the intracontinental connection types defined by the TIA.⁴ TSB37-A further defines three sets of "impairment types" for connection type 17. These are labeled 17a, 17b, and 17c and differ according to certain transmission characteristics.⁵ Of these three, type 17c applies to the switching and interoffice network modeled by HM3.1, in that it does not assume "robbed-bit signaling," an out-dated signaling technique that carries trunk signaling information in the voice connection by occasionally displacing part of the 64 kbps digital voice bit stream. Because HM3.1 assumes out-of-band common-channel signaling for all interoffice connections, robbed-bit signaling is unnecessary, and the entire 64 kbps available in each interoffice digital switched connection is used to transmit subscriber information.

Because the intent of the study was to evaluate the performance of modems over worst-case loop conditions, one should focus on the results observed with loop type 7 (TLC7), defined by the TIA to consist of a 30,000 ft loop containing five sets of load coils and segments using AWG 24 and AWG 22 wire for a total loop resistance of 1300 ohms. The combination of TLC7 with connection type 17c is shown as 17c7 in the attached test results. It is important to note that this network/loop combination requires a type 7 loop at *both* ends of the connection. Thus, the total loop connection in the 17c7 test results includes ten load coils and a total of 60,000 feet of copper wire. Henderson Labs and other organizations involved in such testing use commercially-available loop simulators that precisely emulate the loop characteristics specified in TSB37-A.⁶

The Henderson Labs tests evaluated two pairs of widely-available V.34 modems as described in the appendix. There are two rates shown in the results, a "throughput" and a

³ Telecommunication Industry Association, TSB38, "Test Procedure for Evaluation of 2-Wire Duplex Modems," 1994.

⁴ TIA describes connection type 17 as "the connection configuration to which networks are presently evolving: digital switches in local offices connected through digital transport." TSB37-A at p. 49. Connection types 18 through 24 assume networks containing various pieces of analog switching or interoffice transmission equipment.

⁵ TSB37-A at p. 14.

⁶ The specifications for the seven loop types are very detailed and include, for example, amplitude and envelope delay distortion values at 100 Hz intervals over a 200 - 4000 Hz bandwidth. Annex A to TSB37A, pp 24-41.

“connect speed.” The “connect speed” is the rate, expressed in bits per second, at which the modems under test communicate reliably over the network connection. The “throughput” value indicates the effective end-to-end transmission rate that includes the effect of hardware data compression that is standard with modern modems. The TSB 38 document describes standard file types that are to be used in the throughput tests.

The test results for the two modem pairs using connection type 17c7 (30,000 foot loops with 5 sets of load coils per loop, AWG 22/24 wire) are as follows:

Modem	Throughput	Connect Speed
General DataComm Quester II	74,600 bps	26,400 bps
U. S. Robotics Courier	64,000 bps	21,600 bps

As noted earlier, these are “stable” speeds, and modems connecting at these rates will connect over the same channel type at the same rates with little or no variation.

As one might expect, the results show a dependency of throughput and speed on loop type, with the shorter loop types generally exhibiting slightly higher speeds and throughputs than the longer loops. For example, these same modem pairs, for connection type 17c4 (non-loaded 12,000 foot loops with AWG 26 wire), the results are as follows:

Modem	Throughput	Connect Speed
General DataComm Quester II	88,200 bps	31,200 bps
U. S. Robotics Courier	76,800 bps	26,400 bps

Thus, the difference between average length non-loaded loops and extremely long loaded loops is less than 5000 bps in connect speed, and about 16% in throughput. In addition, these results demonstrate that quality performance is achieved on less expensive modems (the General DataComm Quester II modem retails for about \$150), as well as more expensive ones (the U. S. Robotics Courier modem retails for between \$250 and \$300).⁷

3.0 Conclusion

It is the opinion of the outside plant engineering experts who have contributed to the design of HM3.1 that the use of load coils in rural areas is a prudent design practice in extreme cases. The incidence of loaded loops in the model is rare, typically much less than one-tenth of one percent of all loops. The modem evaluation results summarized here show that, even in those isolated cases in which loading is required, subscribers served by such loops and using current V.34 modems will observe modem performance that is only slightly degraded from that seen by subscribers having much shorter loop connections. Furthermore, Internet and other data service providers often do not even offer dial-up ports supporting data rates even approaching

⁷ Purchasers may select modems based on many features (e.g., ease of use, bundled communications software, etc.) in addition to price and throughput.

those routinely achievable over the long loops considered in this study. In these cases, rural users on long loaded loops will not notice any performance differences whatsoever.

If, however, it is determined that supported universal service should include the capability to deliver a full ISDN BRI signal of 144 kbps over each loop (DSL), a modification of the HM3.1 distribution module that permits elimination of load coils is being developed. The user may specify whether load coils should, or should not be equipped on long loops. If the user elects to eliminate load coils, the model uses the same arrangement of population clusters, towns, and rural road cables as does the unmodified version. First, it ensures that load coils are not required anywhere except along the road cables, and, in those cases in which the road cable distance exceeds 18,000 ft, it serves subscriber locations beyond the 18,000 ft threshold with low-capacity remote terminals. These remote terminals are in turn connected to "host" terminals in the town clusters using T1 connections on HDSL (high bit rate digital subscriber line) equipment. Thus, the model does not install unnecessarily expensive optical fiber cable and terminals in sparsely-populated rural areas. Instead, it relies on economic forward-looking transmission technology that uses low-cost digital remote terminal equipment and copper cables. The low-capacity remote terminals used in this modification may be equipped with ISDN basic rate interfaces to allow all subscribers in the model to obtain ISDN BRI service.

April 28, 1997

Note: In the following Henderson Laboratories Reports, the modem throughputs and connect speeds for each switching/signaling/interoffice network configuration are classified by seven different loop types: TLC1 to TLC7. The length and loading characteristics of these loop configurations are as follows:

TLC1 2 kft total: all on 26 AWG Cu

TLC2 7 kft total: 4 kft 26 AWG Cu, 3 kft 24 AWG Cu

TLC3 8.5 kft total: 7 kft 26 AWG Cu, 1.5 kft 26 AWG Cu Bridged Tap

TLC4 12 kft total: all on 26 AWG Cu

TLC5 15 kft total: 9 kft 26 AWG Cu, 6 kft 24 AWG Cu, 1.5 kft 26 AWG Bridged Tap

TLC6 30 kft total: 4 load coils, 15 kft 24 AWG Cu, 15 kft 22 AWG Cu

TLC7 30 kft total: 5 load coils, 15 kft 24 AWG Cu, 15 kft 22 AWG Cu

HENDERSON LABORATORIES CORPORATION

Modem Insight Report for:
Hatfield Associates - Job #-0932

Section 15

TSB-38 Throughput vs 100% Network Model Coverage
USR Courier vs USR Courier



Henderson Laboratories, Inc.

San Diego Standards Lab

Arthur L. Wallace
Director - Production

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Escondido, CA 92026

(619) 739-9600 (619) 738-4202 Fax
Awallace@Henderson-Labs.Com

*** THROUGHPUT vs NETWORK MODEL COVERAGE ***

Job No: 0932		Date 04/23/97					
Test Model B: USR Courier		Serial No. 121806					
Reference Model A: USR Courier		Serial No. 249691					
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKIT\S2_THR1.TST					
		suite file = C:\TASKIT\S2_THR2.TST					
Notes: This page contains unsorted raw data from TAS TSB-38 Throughput tests. Line types listed as "0" throughput = Failed to connect. Line types listed as "0*" throughput = Connection attained, modems fail to pass 100% of the data file required by the standard. Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.							
LINE	TLC1	TLC2	TLC3	TLC4	TLC5	TLC6	TLC7
17C	84,700	84,200	76,800	76,800	68,600	63,000	64,000
18C	84,700	87,800	76,800	84,500	68,600	63,200	64,000
19C	70,100	76,900	63,200	68,500	62,900	57,900	63,400
20C	54,100	57,100	62,800	63,900	57,700	56,800	56,900
21C	87,900	87,900	76,900	87,900	70,100	63,600	38,400
17B	75,800	75,500	68,600	68,500	62,900	62,400	61,300
17A	68,500	68,500	68,500	68,600	63,700	57,700	57,200
23C	68,500	76,900	63,600	67,700	63,600	57,800	57,200
24C	63,800	76,800	63,400	68,500	64,100	58,000	57,900
18B	76,400	76,800	67,600	68,600	62,900	57,700	57,800
18A	68,600	76,200	66,800	68,500	64,200	57,800	58,000
22C	76,800	84,900	68,600	76,800	63,000	57,200	46,800
19B	68,500	67,500	63,400	63,700	63,600	57,100	58,000
19A	63,600	67,600	63,900	63,800	57,200	53,100	57,900
21B	84,900	87,900	68,500	84,300	61,800	64,100	63,700
21A	76,900	87,800	68,600	76,900	63,000	56,800	57,300
20B	63,700	63,100	64,000	55,100	57,500	56,800	57,000
20A	64,100	57,000	50,800	48,600	57,900	51,300	51,000
23B	57,000	58,100	51,300	56,900	46,800	46,800	51,300
23A	45,500	51,300	38,900	46,300	41,600	38,700	38,700
24B	63,600	64,000	57,200	63,000	57,900	51,400	57,900
24A	51,400	57,800	51,300	57,800	46,200	45,900	46,400
22B	76,800	84,100	63,900	76,900	62,800	55,200	52,200
22A	68,500	76,800	57,400	68,500	57,700	50,900	55,900

*** THROUGHPUT TEST CONNECT SPEEDS ***

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKIT\S2_THR1.TST					
		suite file = C:\TASKIT\S2_THR2.TST					
Notes:		This page contains connect speeds in BPS from TAS TSB-38 Throughput tests. Line types listed as "0" throughput = Failed to connect. Line types listed as "0*" throughput = Connection attained, modems fail to pass 100% of the data file required by the standard. Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.					
LINE	TLC1	TLC2	TLC3	TLC4	TLC5	TLC6	TLC7
17C	31,200	31,200	26,400	26,400	26,400	24,000	21,600
18C	28,800	33,600	26,400	28,800	26,400	24,000	21,600
19C	24,000	26,400	21,600	24,000	24,000	21,600	21,600
20C	21,600	24,000	24,000	21,600	21,600	21,600	19,200
21C	33,600	33,600	28,800	33,600	26,400	24,000	24,000
17B	28,800	28,800	26,400	24,000	24,000	24,000	21,600
17A	26,400	26,400	24,000	24,000	24,000	21,600	19,200
23C	26,400	28,800	24,000	26,400	24,000	21,600	19,200
24C	24,000	26,400	24,000	26,400	21,600	21,600	19,200
18B	28,800	28,800	26,400	24,000	24,000	21,600	21,600
18A	26,400	28,800	24,000	24,000	21,600	21,600	21,600
22C	28,800	31,200	26,400	26,400	24,000	21,600	19,200
19B	24,000	26,400	21,600	24,000	21,600	21,600	21,600
19A	21,600	24,000	21,600	21,600	21,600	19,200	19,200
21B	31,200	33,600	26,400	31,200	26,400	21,600	21,600
21A	28,800	33,600	24,000	26,400	24,000	19,200	19,200
20B	24,000	21,600	24,000	19,200	21,600	21,600	21,600
20A	21,600	21,600	19,200	19,200	21,600	19,200	19,200
23B	21,600	21,600	19,200	21,600	16,800	16,800	19,200
23A	16,800	19,200	14,400	16,800	12,000	14,400	14,400
24B	24,000	24,000	21,600	24,000	19,200	19,200	21,600
24A	19,200	21,600	19,200	21,600	16,800	16,800	16,800
22B	28,800	31,200	24,000	28,800	21,600	19,200	19,200
22A	26,400	28,800	21,600	26,400	21,600	16,800	16,800

*** THROUGHPUT TEST RESULTS ***
Sorted by Throughput

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKIT\S2_THR1.TST					
		suite file = C:\TASKIT\S2_THR2.TST					
Notes:		This page contains data from TAS TSB-38 Throughput tests sorted by value.					
		Line types listed as "0" throughput = Failed to connect.					
		Throughput = Measured throughput in bits per second.					
		Speed = Connect speed.					
		Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.					
Line	Throughput	Speed			Line	Throughput	Speed
21c7	38,400	24,000			21a6	56,800	19,200
23a6	38,700	14,400			20c6	56,800	21,600
23a7	38,700	14,400			20b6	56,800	21,600
23a3	38,900	14,400			20c7	56,900	19,200
23a5	41,600	12,000			23a2	57,000	19,200
24a6	45,900	16,800			23b1	57,000	21,600
24a5	46,200	16,800			20a2	57,000	21,600
23a4	46,300	16,800			20b7	57,000	21,600
24a7	46,400	16,800			19b6	57,100	21,600
23b5	46,800	16,800			20c2	57,100	24,000
23b6	46,800	16,800			23c7	57,200	19,200
22c7	46,800	19,200			17a7	57,200	19,200
20a4	48,600	19,200			19a5	57,200	21,600
20a3	50,800	19,200			24b3	57,200	21,600
22a6	50,900	16,800			23b4	57,200	21,600
20a7	51,000	19,200			22c6	57,200	21,600
23b3	51,300	19,200			21a7	57,300	19,200
24a3	51,300	19,200			22a3	57,400	21,600
20a6	51,300	19,200			20b5	57,500	21,600
23b7	51,300	19,200			20c5	57,700	21,600
24a1	51,400	19,200			17a6	57,700	21,600
24b6	51,400	19,200			18b6	57,700	21,600
22b7	52,200	19,200			22a5	57,700	21,600
19a6	53,100	19,200			24a2	57,800	21,600
20c1	54,100	21,600			23c6	57,800	21,600
20b4	55,100	19,200			18a6	57,800	21,600
22b6	55,200	19,200			18b7	57,800	21,600
22a7	55,900	16,800			24a4	57,800	21,600

* THROUGHPUT TEST RESULTS *

Sorted by Throughput

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKIT\S2_THR1.TST					
		suite file = C:\TASKIT\S2_THR2.TST					
Notes:		This page contains data from TAS TSB-38 Throughput tests sorted by value.					
		Line types listed as "0" throughput = Failed to connect.					
		Throughput = Measured throughput in bits per second.					
		Speed = Connect speed.					
		Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.					
Line	Throughput	Speed			Line	Throughput	Speed
24c7	57,900	19,200			19a1	63,600	21,600
24b5	57,900	19,200			19b5	63,600	21,600
19a7	57,900	19,200			23c3	63,600	24,000
19c6	57,900	21,600			23c5	63,600	24,000
20a5	57,900	21,600			24b1	63,600	24,000
24b7	57,900	21,600			21c6	63,600	24,000
24c6	58,000	21,600			21b7	63,700	21,600
18a7	58,000	21,600			17a5	63,700	24,000
19b7	58,000	21,600			20b1	63,700	24,000
23b2	58,100	21,600			19b4	63,700	24,000
17b7	61,300	21,600			19a4	63,800	21,600
21b5	61,800	26,400			24c1	63,800	24,000
17b6	62,400	24,000			20c4	63,900	21,600
22b5	62,800	21,600			19a3	63,900	21,600
20c3	62,800	24,000			22b3	63,900	24,000
19c5	62,900	24,000			17c7	64,000	21,600
17b5	62,900	24,000			18c7	64,000	21,600
18b5	62,900	24,000			24b2	64,000	24,000
17c6	63,000	24,000			20b3	64,000	24,000
22c5	63,000	24,000			24c5	64,100	21,600
21a5	63,000	24,000			21b6	64,100	21,600
24b4	63,000	24,000			18a5	64,200	21,600
20b2	63,100	21,600			18a3	66,800	24,000
19c3	63,200	21,600			19b2	67,500	26,400
18c6	63,200	24,000			19a2	67,600	24,000
19c7	63,400	21,600			18b3	67,600	26,400
19b3	63,400	21,600			23c4	67,700	26,400
24c3	63,400	24,000			19c4	68,500	24,000

* THROUGHPUT TEST RESULTS *

Sorted by Throughput

Job No: 0932				Date 04/23/97			
Test Model B: USR Courier				Serial No. 121806			
Reference Model A: USR Courier				Serial No. 249691			
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKITS2_THR1.TST					
		suite file = C:\TASKITS2_THR2.TST					
Notes: This page contains data from TAS TSB-38 Throughput tests sorted by value.							
Line types listed as "0" throughput = Failed to connect.							
Throughput = Measured throughput in bits per second.							
Speed = Connect speed.							
Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.							
Line	Throughput	Speed			Line	Throughput	Speed
17b4	68,500	24,000			24c2	76,800	26,400
17a3	68,500	24,000			22c4	76,800	26,400
19b1	68,500	24,000			22c1	76,800	28,800
18a4	68,500	24,000			18b2	76,800	28,800
17a1	68,500	26,400			22b1	76,800	28,800
23c1	68,500	26,400			22a2	76,800	28,800
17a2	68,500	26,400			23a1	76,900	16,800
24c4	68,500	26,400			20a1	76,900	21,600
21b3	68,500	26,400			19c2	76,900	26,400
22a1	68,500	26,400			21a4	76,900	26,400
22a4	68,500	26,400			21c3	76,900	28,800
17a4	68,600	24,000			23c2	76,900	28,800
18b4	68,600	24,000			21a1	76,900	28,800
21a3	68,600	24,000			22b4	76,900	28,800
17c5	68,600	26,400			22b2	84,100	31,200
18c5	68,600	26,400			17c2	84,200	31,200
18a1	68,600	26,400			21b4	84,300	31,200
17b3	68,600	26,400			18c4	84,500	28,800
22c3	68,600	26,400			18c1	84,700	28,800
19c1	70,100	24,000			17c1	84,700	31,200
21c5	70,100	26,400			22c2	84,900	31,200
17b2	75,500	28,800			21b1	84,900	31,200
17b1	75,800	28,800			18c2	87,800	33,600
18a2	76,200	28,800			21a2	87,800	33,600
18b1	76,400	28,800			21c1	87,900	33,600
17c4	76,800	26,400			21c2	87,900	33,600
17c3	76,800	26,400			21c4	87,900	33,600
18c3	76,800	26,400			21b2	87,900	33,600

* THROUGHPUT TEST RESULTS *

Sorted by Line Type

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKIT\S2_THR1.TST					
		suite file = C:\TASKIT\S2_THR2.TST					
Notes:							
This page contains data from TAS TSB-38 Throughput tests sorted by Line type.							
Line types listed as "0" throughput = Failed to connect.							
Throughput = Measured throughput in bits per second.							
Speed = Connect speed.							
Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.							
Line	TLC	Throughput	Speed	Line	TLC	Throughput	Speed
17A	1	68,500	26,400	18B	1	76,400	28,800
17A	2	68,500	26,400	18B	2	76,800	28,800
17A	3	68,500	24,000	18B	3	67,600	26,400
17A	4	68,600	24,000	18B	4	68,600	24,000
17A	5	63,700	24,000	18B	5	62,900	24,000
17A	6	57,700	21,600	18B	6	57,700	21,600
17A	7	57,200	19,200	18B	7	57,800	21,600
17B	1	75,800	28,800	18C	1	84,700	28,800
17B	2	75,500	28,800	18C	2	87,800	33,600
17B	3	68,600	26,400	18C	3	76,800	26,400
17B	4	68,500	24,000	18C	4	84,500	28,800
17B	5	62,900	24,000	18C	5	68,600	26,400
17B	6	62,400	24,000	18C	6	63,200	24,000
17B	7	61,300	21,600	18C	7	64,000	21,600
17C	1	84,700	31,200	19A	1	63,600	21,600
17C	2	84,200	31,200	19A	2	67,600	24,000
17C	3	76,800	26,400	19A	3	63,900	21,600
17C	4	76,800	26,400	19A	4	63,800	21,600
17C	5	68,600	26,400	19A	5	57,200	21,600
17C	6	63,000	24,000	19A	6	53,100	19,200
17C	7	64,000	21,600	19A	7	57,900	19,200
18A	1	68,600	26,400	19B	1	68,500	24,000
18A	2	76,200	28,800	19B	2	67,500	26,400
18A	3	66,800	24,000	19B	3	63,400	21,600
18A	4	68,500	24,000	19B	4	63,700	24,000
18A	5	64,200	21,600	19B	5	63,600	21,600
18A	6	57,800	21,600	19B	6	57,100	21,600
18A	7	58,000	21,600	19B	7	58,000	21,600

*** THROUGHPUT TEST RESULTS ***
Sorted by Line Type

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKIT\S2_THR1.TST					
		suite file = C:\TASKIT\S2_THR2.TST					
Notes: This page contains data from TAS TSB-38 Throughput tests sorted by Line type. Line types listed as "0" throughput = Failed to connect. Throughput = Measured throughput in bits per second. Speed = Connect speed. Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.							
Line	TLC	Throughput	Speed	Line	TLC	Throughput	Speed
19C	1	70,100	24,000	21A	1	76,900	28,800
19C	2	76,900	26,400	21A	2	87,800	33,600
19C	3	63,200	21,600	21A	3	68,600	24,000
19C	4	68,500	24,000	21A	4	76,900	26,400
19C	5	62,900	24,000	21A	5	63,000	24,000
19C	6	57,900	21,600	21A	6	56,800	19,200
19C	7	63,400	21,600	21A	7	57,300	19,200
20A	1	64,100	21,600	21B	1	84,900	31,200
20A	2	57,000	21,600	21B	2	87,900	33,600
20A	3	50,800	19,200	21B	3	68,500	26,400
20A	4	48,600	19,200	21B	4	84,300	31,200
20A	5	57,900	21,600	21B	5	61,800	26,400
20A	6	51,300	19,200	21B	6	64,100	21,600
20A	7	51,000	19,200	21B	7	63,700	21,600
20B	1	63,700	24,000	21C	1	87,900	33,600
20B	2	63,100	21,600	21C	2	87,900	33,600
20B	3	64,000	24,000	21C	3	76,900	28,800
20B	4	55,100	19,200	21C	4	87,900	33,600
20B	5	57,500	21,600	21C	5	70,100	26,400
20B	6	56,800	21,600	21C	6	63,600	24,000
20B	7	57,000	21,600	21C	7	38,400	24,000
20C	1	54,100	21,600	22A	1	68,500	26,400
20C	2	57,100	24,000	22A	2	76,800	28,800
20C	3	62,800	24,000	22A	3	57,400	21,600
20C	4	63,900	21,600	22A	4	68,500	26,400
20C	5	57,700	21,600	22A	5	57,700	21,600
20C	6	56,800	21,600	22A	6	50,900	16,800
20C	7	56,900	19,200	22A	7	55,900	16,800

*** THROUGHPUT TEST RESULTS ***
Sorted by Line Type

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKIT\S2_THR1.TST					
		suite file = C:\TASKIT\S2_THR2.TST					
Notes:		This page contains data from TAS TSB-38 Throughput tests sorted by Line type. Line types listed as "0" throughput = Failed to connect. Throughput = Measured throughput in bits per second. Speed = Connect speed. Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.					
Line	TLC	Throughput	Speed	Line	TLC	Throughput	Speed
22B	1	76,800	28,800	23C	1	68,500	26,400
22B	2	84,100	31,200	23C	2	76,900	28,800
22B	3	63,900	24,000	23C	3	63,600	24,000
22B	4	76,900	28,800	23C	4	67,700	26,400
22B	5	62,800	21,600	23C	5	63,600	24,000
22B	6	55,200	19,200	23C	6	57,800	21,600
22B	7	52,200	19,200	23C	7	57,200	19,200
22C	1	76,800	28,800	24A	1	51,400	19,200
22C	2	84,900	31,200	24A	2	57,800	21,600
22C	3	68,600	26,400	24A	3	51,300	19,200
22C	4	76,800	26,400	24A	4	57,800	21,600
22C	5	63,000	24,000	24A	5	46,200	16,800
22C	6	57,200	21,600	24A	6	45,900	16,800
22C	7	46,800	19,200	24A	7	46,400	16,800
23A	1	45,500	16,800	24B	1	63,600	24,000
23A	2	51,300	19,200	24B	2	64,000	24,000
23A	3	38,900	14,400	24B	3	57,200	21,600
23A	4	46,300	16,800	24B	4	63,000	24,000
23A	5	41,600	12,000	24B	5	57,900	19,200
23A	6	38,700	14,400	24B	6	51,400	19,200
23A	7	38,700	14,400	24B	7	57,900	21,600
23B	1	57,000	21,600	24C	1	63,800	24,000
23B	2	58,100	21,600	24C	2	76,800	26,400
23B	3	51,300	19,200	24C	3	63,400	24,000
23B	4	56,900	21,600	24C	4	68,500	26,400
23B	5	46,800	16,800	24C	5	64,100	21,600
23B	6	46,800	16,800	24C	6	58,000	21,600
23B	7	51,300	19,200	24C	7	57,900	19,200

*** THROUGHPUT TEST RESULTS ***

Sorted by Likelihood of Occurrence

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKIT\S2_THR1.TST					
		suite file = C:\TASKIT\S2_THR2.TST					
Notes: This page contains score data from TAS TSB-38 Throughput tests. The data is sorted according to Percentage of Coverage as stipulated in TSB-38. Throughput = Measured throughput in bits per second. Speed = Connect speed. Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.							
Line	Percent	Throughput	Speed	Line	Score	Throughput	Speed
17c1	22.8620%	84,700	31,200	17c7	.6958%	64,000	21,600
17c2	11.4310%	84,200	31,200	23a1	.6900%	76,900	16,800
18c1	7.5440%	84,700	28,800	18b1	.6440%	76,400	28,800
17c4	4.9700%	76,800	26,400	17b2	.6440%	75,500	28,800
17c3	4.9700%	76,800	26,400	18a1	.6440%	68,600	26,400
19c1	4.2780%	70,100	24,000	17a2	.6440%	68,500	26,400
17c5	3.9760%	68,600	26,400	20c3	.4700%	62,800	24,000
18c2	3.7720%	87,800	33,600	20c4	.4700%	63,900	21,600
20c1	2.1620%	54,100	21,600	21c4	.4300%	87,900	33,600
19c2	2.1390%	76,900	26,400	21c3	.4300%	76,900	28,800
21c1	1.9780%	87,900	33,600	22c1	.4140%	76,800	28,800
18c3	1.6400%	76,800	26,400	23c2	.3910%	76,900	28,800
18c4	1.6400%	84,500	28,800	24c2	.3910%	76,800	26,400
18c5	1.3120%	68,600	26,400	20c5	.3760%	57,700	21,600
17b1	1.2880%	75,800	28,800	21c5	.3440%	70,100	26,400
17a1	1.2880%	68,500	26,400	18a2	.3220%	76,200	28,800
20c2	1.0810%	57,100	24,000	18b2	.3220%	76,800	28,800
21c2	.9890%	87,900	33,600	17b4	.2800%	68,500	24,000
19c4	.9300%	68,500	24,000	17a4	.2800%	68,600	24,000
19c3	.9300%	63,200	21,600	17b3	.2800%	68,600	26,400
17c6	.7952%	63,000	24,000	17a3	.2800%	68,500	24,000
24c1	.7820%	63,800	24,000	18c6	.2624%	63,200	24,000
23c1	.7820%	68,500	26,400	23c7	.2380%	57,200	19,200
19c5	.7440%	62,900	24,000	19b1	.2300%	68,500	24,000

*** THROUGHPUT TEST RESULTS FILE ***

Sorted by Likelihood of Occurrence

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKITS2_THR1.TST					
		suite file = C:\TASKITS2_THR2.TST					
Notes:		This page contains score data from TAS TSB-38 Throughput tests. The data is sorted according to Percentage of Coverage as stipulated in TSB-38. Throughput = Measured throughput in bits per second. Speed = Connect speed. Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.					
Line	Score	Throughput	Speed	Line	Score	Throughput	Speed
19a1	.2300%	63,600	21600	18a5	.1120%	64,200	21,600
18c7	.2296%	64,000	21,600	22c3	.0900%	68,600	26,400
17b5	.2240%	62,900	24,000	22c4	.0900%	76,800	26,400
17a5	.2240%	63,700	24,000	21b2	.0805%	87,900	33,600
22c2	.2070%	84,900	31,200	21a2	.0805%	87,800	33,600
24c3	.1700%	63,400	24,000	20c6	.0752%	56,800	21,600
23c3	.1700%	63,600	24,000	22c5	.0720%	63,000	24,000
23c4	.1700%	67,700	26,400	24b1	.0690%	63,600	24,000
24c4	.1700%	68,500	26,400	23b1	.0690%	57,000	21,600
21a1	.1610%	76,900	28,800	24a1	.0690%	51,400	19,200
21b1	.1610%	84,900	31,200	21c6	.0688%	63,600	24,000
19c6	.1488%	57,900	21,600	20c7	.0658%	56,900	19,200
18b4	.1400%	68,600	24,000	21c7	.0602%	38,400	24,000
18a4	.1400%	68,500	24,000	20b2	.0575%	63,100	21,600
18b3	.1400%	67,600	26,400	20a2	.0575%	57,000	21,600
18a3	.1400%	66,800	24,000	19b4	.0500%	63,700	24,000
23c5	.1360%	63,600	24,000	19b3	.0500%	63,400	21,600
24c5	.1360%	64,100	21,600	19a3	.0500%	63,900	21,600
19c7	.1302%	63,400	21,600	19a4	.0500%	63,800	21,600
19b2	.1150%	67,500	26,400	17b6	.0448%	62,400	24,000
19a2	.1150%	67,600	24,000	17a6	.0448%	57,700	21,600
20b1	.1150%	63,700	24,000	19b5	.0400%	63,600	21,600
20a1	.1150%	76,900	21,600	19a5	.0400%	57,200	21,600
18b5	.1120%	62,900	24,000	17b7	.0392%	61,300	21,600

*** THROUGHPUT TEST RESULTS FILE ***

Sorted by Likelihood of Occurrence

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKITS2_THR1.TST					
		suite file = C:\TASKITS2_THR2.TST					
Notes: This page contains score data from TAS TSB-38 Throughput tests. The data is sorted according to Percentage of Coverage as stipulated in TSB-38. Throughput = Measured throughput in bits per second. Speed = Connect speed. Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.							
Line	Score	Throughput	Speed	Line	Score	Throughput	Speed
17a7	.0392%	57,200	19,200	18b7	.0196%	57,800	21,600
21b4	.0350%	84,300	31,200	18a7	.0196%	58,000	21,600
21a4	.0350%	76,900	26,400	24b3	.0150%	57,200	21,600
21b3	.0350%	68,500	26,400	24b4	.0150%	63,000	24,000
21a3	.0350%	68,600	24,000	24a4	.0150%	57,800	21,600
23b2	.0345%	58,100	21,600	23b3	.0150%	51,300	19,200
23a2	.0345%	57,000	19,200	23a3	.0150%	38,900	14,400
24b2	.0345%	64,000	24,000	24a3	.0150%	51,300	19,200
24a2	.0345%	57,800	21,600	23b4	.0150%	57,200	21,600
21b5	.0280%	61,800	26,400	23a4	.0150%	46,300	16,800
23c6	.0272%	57,800	21,600	22c6	.0144%	57,200	21,600
24c6	.0272%	58,000	21,600	22c7	.0126%	46,800	19,200
20b3	.0250%	64,000	24,000	24b5	.0120%	57,900	19,200
20a3	.0250%	50,800	19,200	23b5	.0120%	46,800	16,800
20b4	.0250%	55,100	19,200	24a5	.0120%	46,200	16,800
20a4	.0250%	48,600	19,200	23a5	.0120%	41,600	12,000
24c7	.0238%	57,900	19,200	22b2	.0115%	84,100	31,200
22b1	.0230%	76,800	28,800	22a2	.0115%	76,800	28,800
22a1	.0230%	68,500	26,400	19b6	.0080%	57,100	21,600
21a5	.0224%	63,000	24,000	19a6	.0080%	53,100	19,200
18b6	.0224%	57,700	21,600	19b7	.0070%	58,000	21,600
20b5	.0200%	57,500	21,600	19a7	.0070%	57,900	19,200
20a5	.0200%	57,900	21,600	21b6	.0056%	64,100	21,600
18a6	.0196%	57,800	21,600	21a6	.0056%	56,800	19,200

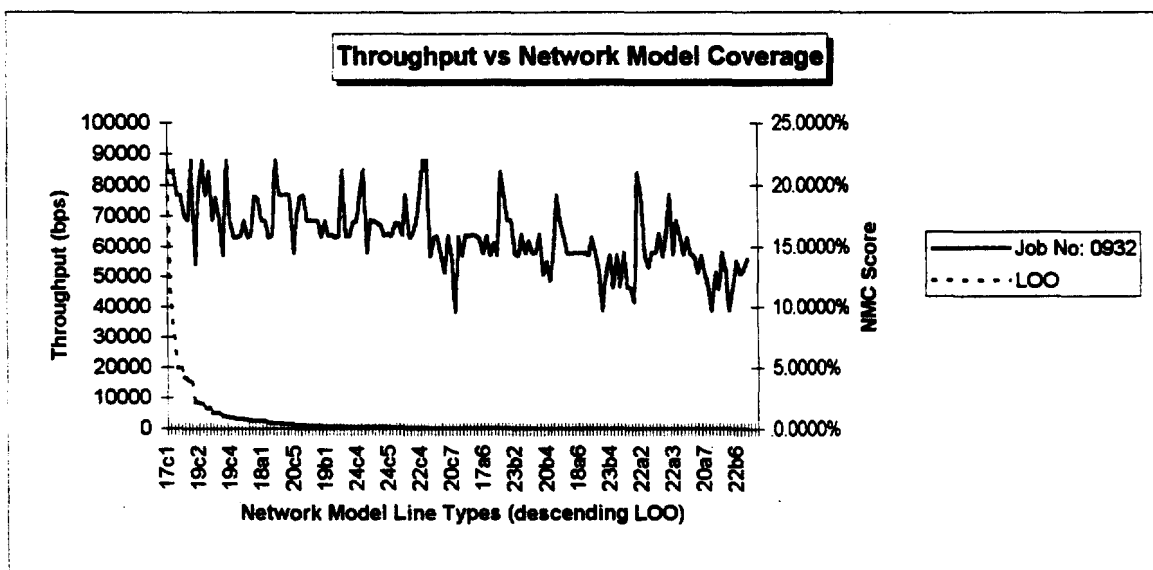
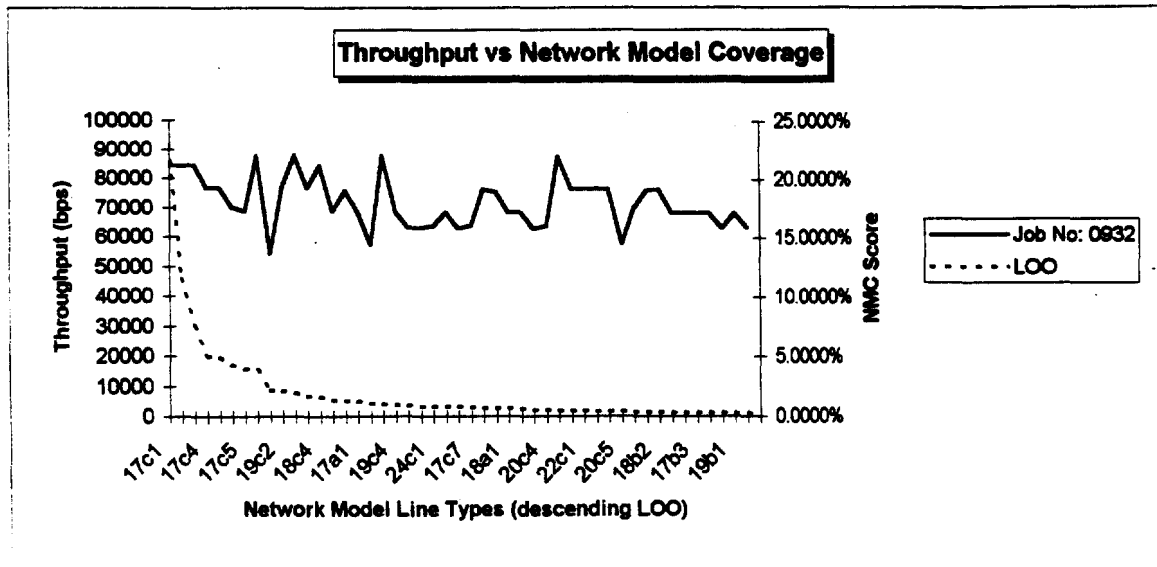
*** THROUGHPUT TEST RESULTS FILE ***

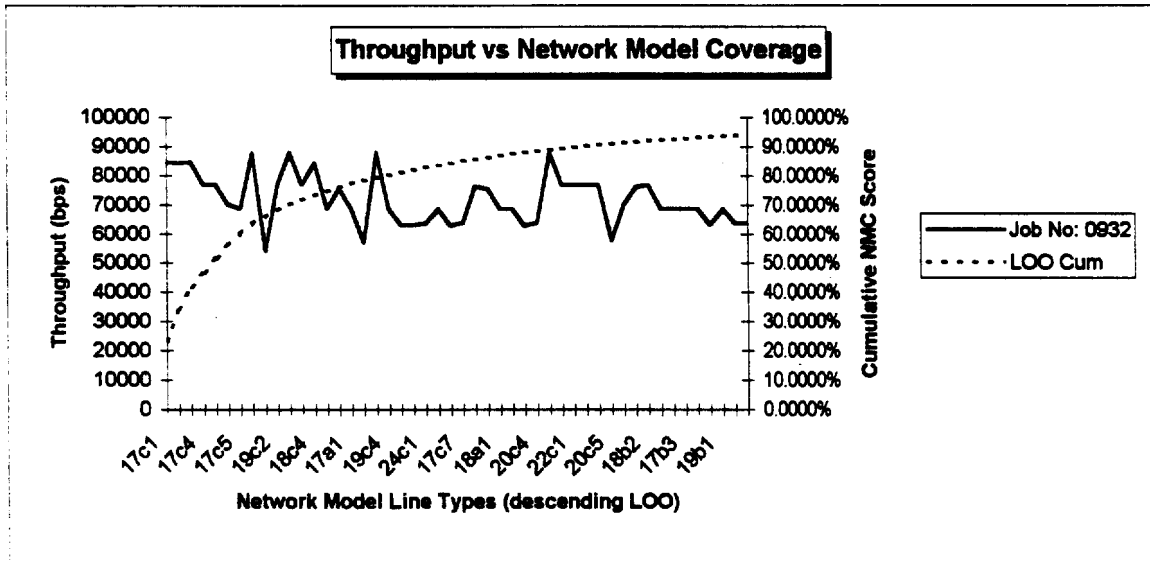
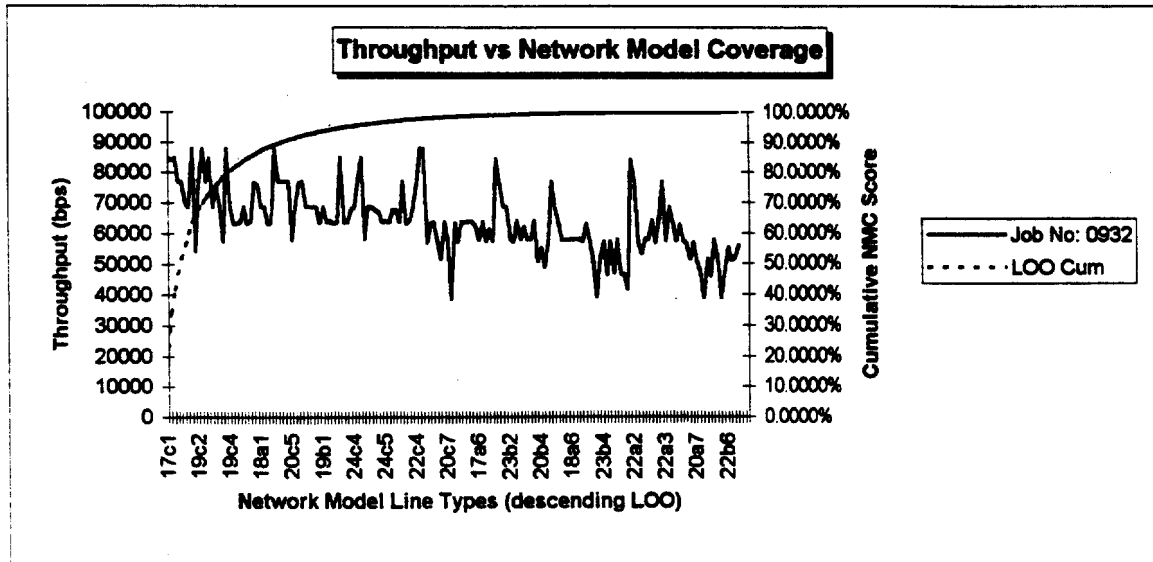
Sorted by Likelihood of Occurrence

Job No: 0932		Date 04/23/97					
Test Model B:	USR Courier	Serial No.	121806				
Reference Model A:	USR Courier	Serial No.	249691				
TAS Serial No. ST24940314		A>B, Orig A, Test B					
Test Parameters:	Throughput vs Network Model Coverage						
Files Used:	mdm_A_file = C:\TASKIT\15-0932A.MDM						
	mdm_B_file = C:\TASKIT\15-0932B.MDM						
	suite file = C:\TASKIT\S2_THR1.TST						
	suite file = C:\TASKIT\S2_THR2.TST						
Notes:	This page contains score data from TAS TSB-38 Throughput tests. The data is sorted according to Percentage of Coverage as stipulated in TSB-38.						
	Throughput = Measured throughput in bits per second.						
	Speed = Connect speed.						
	Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.						
Line	Score	Throughput	Speed				
22b3	.0050%	63,900	24,000				
22b4	.0050%	76,900	28,800				
22a3	.0050%	57,400	21,600				
22a4	.0050%	68,500	26,400				
21b7	.0049%	63,700	21,600				
21a7	.0049%	57,300	19,200				
22b5	.0040%	62,800	21,600				
22a5	.0040%	57,700	21,600				
20b6	.0040%	56,800	21,600				
20a6	.0040%	51,300	19,200				
20b7	.0035%	57,000	21,600				
20a7	.0035%	51,000	19,200				
23b6	.0024%	46,800	16,800				
23a6	.0024%	38,700	14,400				
24b6	.0024%	51,400	19,200				
24a6	.0024%	45,900	16,800				
24b7	.0021%	57,900	21,600				
23b7	.0021%	51,300	19,200				
23a7	.0021%	38,700	14,400				
24a7	.0021%	46,400	16,800				
22b6	.0008%	55,200	19,200				
22a6	.0008%	50,900	16,800				
22b7	.0007%	52,200	19,200				
22a7	.0007%	55,900	16,800				

*** THROUGHPUT vs LIKELIHOOD OF OCCURRENCE ***

Job No: 0932				Date 04/23/97			
Test Model B:		USR Courier		Serial No.		121806	
Reference Model A:		USR Courier		Serial No.		249691	
TAS Serial No. ST24940314				A>B, Orig A, Test B			
Test Parameters:		Throughput vs Network Model Coverage					
Files Used:		mdm_A_file = C:\TASKIT\15-0932A.MDM					
		mdm_B_file = C:\TASKIT\15-0932B.MDM					
		suite file = C:\TASKITS2_THR1.TST					
		suite file = C:\TASKITS2_THR1.TST					
Notes: This page contains score data from TAS TSB-38 Throughput tests. The data is sorted according to Percentage of Coverage as stipulated in TSB-38. Throughput = Measured throughput in bits per second. Tests listed comprise 95% of all line types. X = Not Used For 95% Tests.							
Line	Percent	Throughput			Line	Percent	Throughput
17c1	22.8620%	84,700			17a2	0.6440%	68,500
17c2	11.4310%	84,200			20c3	0.4700%	62,800
18c1	7.5440%	84,700			20c4	0.4700%	63,900
17c4	4.9700%	76,800			21c4	0.4300%	87,900
17c3	4.9700%	76,800			21c3	0.4300%	76,900
19c1	4.2780%	70,100			22c1	0.4140%	76,800
17c5	3.9760%	68,600			23c2	0.3910%	76,900
18c2	3.7720%	87,800			24c2	0.3910%	76,800
20c1	2.1620%	54,100			20c5	0.3760%	57,700
19c2	2.1390%	76,900			21c5	0.3440%	70,100
21c1	1.9780%	87,900			18a2	0.3220%	76,200
18c3	1.6400%	76,800			18b2	0.3220%	76,800
18c4	1.6400%	84,500			17b4	0.2800%	68,500
18c5	1.3120%	68,600			17a4	0.2800%	68,600
17b1	1.2880%	75,800			17b3	0.2800%	68,600
17a1	1.2880%	68,500			17a3	0.2800%	68,500
20c2	1.0810%	57,100			18c6	0.2624%	63,200
21c2	0.9890%	87,900			19b1	0.2300%	68,500
19c4	0.9300%	68,500			19a1	0.2300%	63,600
19c3	0.9300%	63,200			18c7	0.2296%	64,000
17c6	0.7952%	63,000			17b5	0.2240%	62,900
24c1	0.7820%	63,800			17a5	0.2240%	63,700
23c1	0.7820%	68,500			22c2	0.2070%	84,900
19c5	0.7440%	62,900			24c3	0.1700%	63,400
17c7	0.6958%	64,000			23c3	0.1700%	63,600
18b1	0.6440%	76,400			23c4	0.1700%	67,700
17b2	0.6440%	75,500			24c4	0.1700%	68,500
18a1	0.6440%	68,600			21a1	0.1610%	76,900





HENDERSON LABORATORIES CORPORATION

Insight Test Standards for:
Hatfield Associates - Job #-0932

Appendix A

Test Conditions Covered:
TSB-37A (Lines 17-24)





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TSB-37A (17-24): Impairment Combination Table

Impairments	Units	Line 17a	Line 17b	Line 17c	Line 18a	Line 18b	Line 18c
Network: (EO to EO) Parameters							
Connection Type - Score	%	55.3	55.3	55.3	19.2	19.2	19.2
Combination - Score	%	2.8	2.8	49.7	1.4	1.4	16.4
1. Attenuation Distortion	EIA	None	None	None	None	None	None
2. Envelope Delay Distortion		None	None	None	None	None	None
3. 1 kHz Loss	dB	6.0	6.0	6.0	8.0	6.0	6.0
4. Noise							
4a. Background Noise	dBm	22	22	22	22	22	22
4b. Tone to Noise Ratio	dB	N/A	N/A	N/A	N/A	N/A	N/A
5. Phase Jitter							
5a. P-P deviation	Deg.	None	None	None	None	None	None
5b. Frequency	Hz	None	None	None	None	None	None
6. IMD- (4Tone)							
6a. 2nd Order (R2)	dB	40	43	50	43	50	55
6b. 3rd Order (R3)	dB	41	44	51	44	51	56
7. Frequency Offset							
7a. FO (A to B)	Hz	None	None	None	None	None	None
7b. FO (B to A)	Hz	None	None	None	None	None	None
8. PCM (64 kbit/s)							
8a. Tandem Links	No	1	1	1	1	1	1
8b. Robbed Bit Signaling		Yes	Yes	No	Yes	Yes	No
8c. Robbed Bit Signaling Location	Link No.	1	1		1	1	
9. ADPCM							
9a. Type		None	None	None	None	None	None
9b. Signaling rate	kbit/s	None	None	None	None	None	None
9c. ADPCM Location		None	None	None	None	None	None
10. Echo							
10a. Round Trip Delay	ms	80	80	80	80	80	80
10b. Trans Hybrid Loss (A)	dB	12	16	20	16	20	22
10c. Trans Hybrid Loss (B)	dB	12	16	20	16	20	22